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CLAIMS

We claim:

1. A process of forming a dielectric layer on a substrate, the process comprising:
 - 5 depositing a colloidal dispersion on a substrate, the colloidal dispersion comprising particles of a dense material dispersed in a solvent, wherein the dense material is a dielectric material or a material convertible to a dielectric material by oxidation or nitridation;
 - drying the colloidal dispersion to form an intermediate layer;
 - 10 infiltrating the intermediate layer with a matrix material to form an infiltrated layer; and
 - curing the infiltrated layer whereby the infiltrated layer is modified forming the dielectric layer.
2. The process of Claim 1 wherein infiltrating the intermediate layer with a
15 matrix material is infiltrating the intermediate layer with a coating solution of a spin-on polymer material.
3. The process of Claim 2 wherein the spin-on polymer material comprises a material selected from the group consisting of silicates, hydrogen silsesquioxanes, organosilsesquioxanes, organosiloxanes, silsesquioxane-silicate copolymers, silazane-
20 based materials, polycarbosilanes, and acetoxysilanes.
4. The process of Claim 2 wherein the spin-on polymer material comprises a species selected from the group consisting of arsenic, antimony, phosphorous, and boron.
5. The process of Claim 1 wherein the particles of the dense material are particles comprising a material selected from the group consisting of silica, silicon,
25 silicon nitride, silicon oxynitride, aluminum, aluminum nitride, and aluminum oxide.
6. The process of Claim 5 wherein the dense material further comprises a species selected from the group consisting of arsenic, antimony, phosphorous, and boron.
7. The process of Claim 5 wherein the particles of the dense material comprise silica.

8. The process of Claim 5 wherein the particles of the dense material comprise silicon.
9. The process of Claim 1 wherein the particles have a characteristic dimension between about 2 nanometers and about 50 nanometers.
- 5 10. The process of Claim 1 wherein the dielectric layer is a pre-metal dielectric layer on an integrated circuit device.
11. The process of Claim 1 wherein the dielectric layer fills a trench in a shallow trench isolation structure.
12. The process of Claim 1 wherein the dielectric layer fills gaps of
10 dimension less than 100 nanometers.
13. The process of Claim 12 wherein the dielectric layer is heated above 700 °C without cracking.
14. The process of Claim 1 wherein the dielectric layer is resistant to standard buffered oxide etchant solutions.
- 15 15. The process of Claim 1 wherein infiltrating the intermediate layer with a matrix material is depositing a matrix material on the intermediate layer by chemical vapor deposition.
16. The process of Claim 1 wherein infiltrating the intermediate layer with a matrix material is depositing a matrix material on the intermediate layer by atomic layer
20 deposition.
17. The process of Claim 15 wherein the matrix material is selected from the group consisting of phosphosilicate glass, borosilicate glass, and borophosphosilicate glass.
18. The process of Claim 1 wherein curing the infiltrated layer whereby the
25 infiltrated layer is modified is curing the infiltrated layer whereby open porosity of the infiltrated layer is minimized.

19. A process of forming a dielectric layer on a substrate, the process comprising:

depositing a colloidal dispersion on a substrate, the colloidal dispersion comprising particles of a dense material dispersed in a solvent, wherein the dense material is a dielectric material or a material convertible to a dielectric material by oxidation or nitridation;

drying the colloidal dispersion to form an intermediate layer;

curing the intermediate layer whereby the intermediate layer is modified everywhere on the substrate, forming the dielectric layer.

20. The process of Claim 19 wherein the particles of the dense material are particles comprising a material selected from the group consisting of silica, silicon, silicon nitride, silicon oxynitride, aluminum, aluminum nitride, and aluminum oxide.

21. The process of Claim 19 wherein the dense material further comprises a species selected from the group consisting of arsenic, antimony, phosphorous, and boron.

22. The process of Claim 19 wherein the particles of the dense material comprise silica.

23. The process of Claim 19 wherein the particles have a characteristic dimension between about 2 nanometers and about 50 nanometers.

24. The process of Claim 19 wherein the dielectric layer is a pre-metal dielectric layer on an integrated circuit device.

25. The process of Claim 19 wherein the dielectric layer fills a trench in a shallow trench isolation structure.

26. The process of Claim 19 wherein the dielectric layer further comprises a spin-on polymer.